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UK CL (Edition J) **B7B BSEB, F2S SCM**
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(54) Energy absorbing structure

(57) The broad end of a conical fibre reinforced plastics structure 18 is positioned so as to receive an impact load, with the narrow end being secured to a relatively fixed structure 16, and the wall of the conical structure being constructed so that the broad end of the structure collapses first and the rest of the structure progressively collapses towards the narrow end.

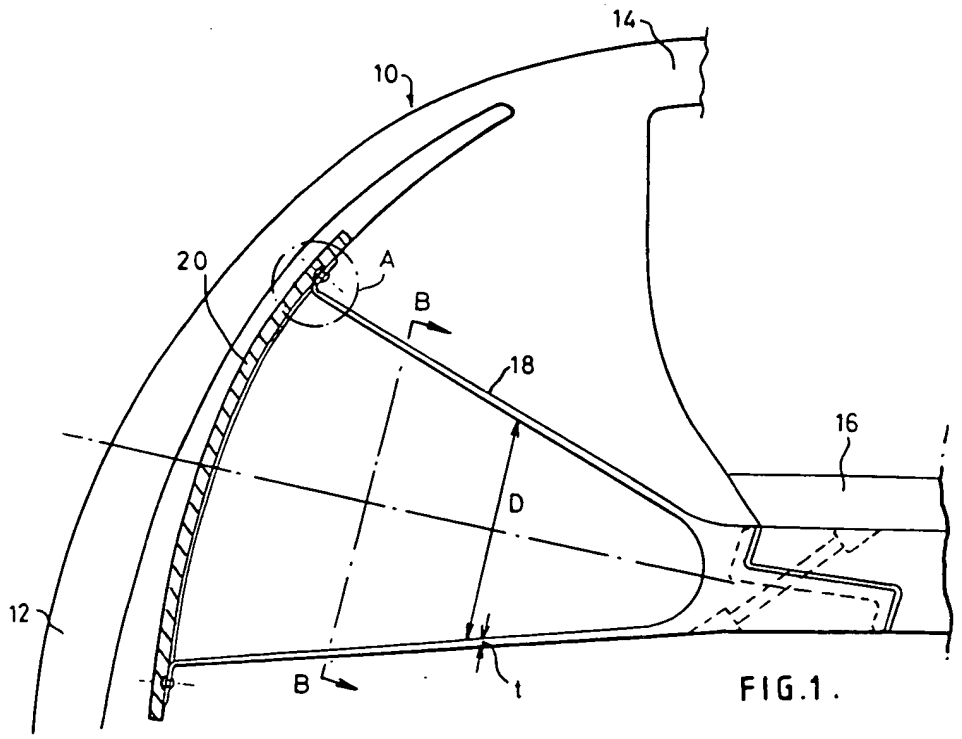

FIG.1.

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ENERGY ABSORBING STRUCTURE

vention relates to an energy absorbing structure
ay have a wide variety of applications but finds
lar application in the automotive field,
larly in the mounting of bumpers on vehicles.

proposals have been made for providing the
basrs of motor vehicles with some energy
ng capability, including filling the bumpers with
d the mounting of collapsible structures between
per structure itself and the body structure.
such arrangements provide a low level of energy
ion (but sufficient to pass statutory low speed
there is still a desire to provide a much
degree of energy absorption in this area.

lso known that a hollow conical structure is a
ficient shape for progressively absorbing energy.
y does the amount of energy absorption increase
ıing takes place as a result of the continually
ing cross sectional area of the cone presentedto
ıct as crushing continues, but also a large base
the cone ensures that the desired crushing
ınce is obtained over a range of ompact
ɔns. This is described in "Crash energy
ion of fibre-reinforced plastics in vehicle
ɔtion" by Hans Vogt, Peter Beardmore and Derek
esented at the Mannheim Conference of the German
ve plastics society.

ıg to the known proposals, however, the broad
the cone is supported on a fixed structure, and
ıct load or energy to be absorbed is received at
l end. This configuration is unsuitable for use
arly on the front bumper of a motor vehicle,

: there is insufficient space at the front of the compartment to package the broad base of the

ng to the present invention, there is provided an absorbing structure arranged between a potential position and a support position, wherein the ıre occupies a generally conical volume with the end of the cone presented to the potential impact ın and the smaller end at the support position, e being constructed so that, working from the end towards the smaller end, the amount of energy d by destruction of the cone progressively es.

he cone in an inverted position means that ng of the structure as an energy absorption for a vehicle bumper becomes possible because ent space may be found for the small end of the st inboard of the end of the vehicle, for example engine compartment or within or below the luggage ment.

dually increasing energy absorption towards the end of the cone can be achieved by increasing l thickness of the cone towards the apex. other strategies for increasing the energy ion can be considered; for example increasing the cement density in the structure or changing the nfiguration locally.

ively rigid end plate can be provided at the end of the cone so that the destruction of the kes place against the plate. For example, the te can be secured to the inner face of a bumper re.

:ger end of the cone is preferably associated with
ering formation to initiate destruction. The
:ing formation could be a chamfer on the end of
ıe.

.ng to a second aspect of the invention, there is
:d a bumper mounting arrangement in a motor
:, wherein a bumper of the motor vehicle is
: to the larger end of a generally conical energy
.ng structure, the smaller end of the structure is
connected to a vehicle frame member, and the
axis of the structure is directed generally
s from the mounting point.

m "generally forwards" includes arrangements
he cone axis is intentionally offset towards the
on of the expected force. The offset could for
be outwards and/or upwards.

ller end of the structure can be constructed so
locates and engages with a frame member,
ly one of the side rails of the vehicle.

ucture is preferably formed by a moulding
, and the fastenings by which the structure is
to the vehicle and to the bumper can be moulded
ɜ structure.

angement may be provided at the front and/or at
ĸ of the vehicle.

ɜntion will now be further described, by way of
, with reference to the accompanying drawing in

1 is a plan view , partly in section, of a motor
bumper arrangement in accordance with the
ɔn;

2 is a section on the line B-B from Figure 1; and

3 is a detail view within the circle A from
1.

1 shows a bumper bar 10 with a front region 12
rap-around side region 14. The motor vehicle
has a side rail 16, only the front edge of which
n. Clearly there will be a corresponding side
the opposite side of the vehicle but this is not
n the Figure.

per bar 10 is connected to the side rail 16 by an
absorbing structure 18. This energy absorbing
re is generally hollow and conical and will be
cted of a reinforced plastics material. An end
r mandrel 20 is fitted on the inside of the
bar to provide a surface against which the
re 18 can be crushed.

ignificant that the broader end of the cone is
forwards, secured to the bumper bar. The energy
ion characteristics are of fundamental
ıce, and it is desired that the front end (ie the
ıd) of the cone be the first to be destroyed when
is absorbed. A specific ramp up of energy
ıon is required. The desired increasing energy
ion characteristic along the cone axis requires
ı consideration of the local wall thickness (t),
thickness: diameter ratio (t/D) and the local
lius (r). These parameters can be traded off to
the desired absorption characteristics.

usually be necessary to provide a triggering
at the larger end of the cone to ensure that
of the cone commences at the desired position.
ple triggering feature is a chamfer as shown at
gure 3. However other alternative triggering

:s are known in the art and could be used here.

'ss section of the cone may be regular but need so. Figure 2 shows by way of example a flattened ection, and here the inclusion of flat areas, ave little energy absorbing ability, provides means of tuning the energy absorption eristics as desired.

ical structure 18 could be manufactured by resin r moulding, filament winding, compression g of thermosetting plastics, compression moulding moplastic plastics, or injection moulding of einforced plastics which may be either etting or thermoplastic.

h the invention has been described here in ion with a bumper bar support, other applications e found wherever energy has to be absorbed, and he force could arrive from within a given cone A possible example of another application is in vehicle steering column assembly where the end of the cone would be directed towards the

ention provides the advantages of tunable energy ion characteristics, in the particular tion described, packaging advantages in that the nd of the cone is packaged near the engine where s at a premium, and the broad end is packaged at ber end where there is available space.

CLAIMS

An energy absorbing structure arranged between
ıtial impact position and a support position,
ı the structure occupies a generally conical
with the larger end of the cone presented to the
.al impact position and the smaller end at the
: position, the cone being constructed so that,
ı from the larger end towards the smaller end, the
of energy absorbed by destruction of the cone
sively increases.

An energy absorbing structure as claimed in
., wherein the gradually increasing energy
ion towards the smaller end of the cone is
d by increasing the wall thickness of the cone
the apex.

An energy absorbing structure as claimed in
, wherein the gradually increasing energy
ion is achieved by increasing the wall
ss:diameter ratio of the cone towards the apex.

An energy absorbing structure as claimed in
, wherein the gradually increasing energy
ion is achieved by modifying the cross sectional
f the cone towards the apex.

An energy absorbing structure as claimed in
ceding claim, wherein an end plate is mounted
e larger end of the cone.

An energy absorbing structure as claimed in
ceding claim, wherein a triggering formation is
ted with the larger end of the cone.

7. A bumper mounting arrangement in a motor vehicle, wherein a bumper of the motor vehicle is secured to the larger end of a generally conical energy absorbing structure, the smaller end of the structure is rigidly connected to a vehicle frame member, and the conical axis of the structure is directed from the mounting point towards the direction of the expected impact.

8. An arrangement as claimed in Claim 7, wherein the smaller end of the structure is constructed so that it locates and engages with a frame member, typically one of the side rails of the vehicle.

9. An arrangement as claimed in Claim 7 or Claim 8, wherein the structure is formed by a moulding process, and the fastenings by which the structure is secured to the vehicle and to the bumper are moulded into the structure.

10. A bumper mounting arrangement in a motor vehicle, substantially as herein described with reference to the accompanying drawing.

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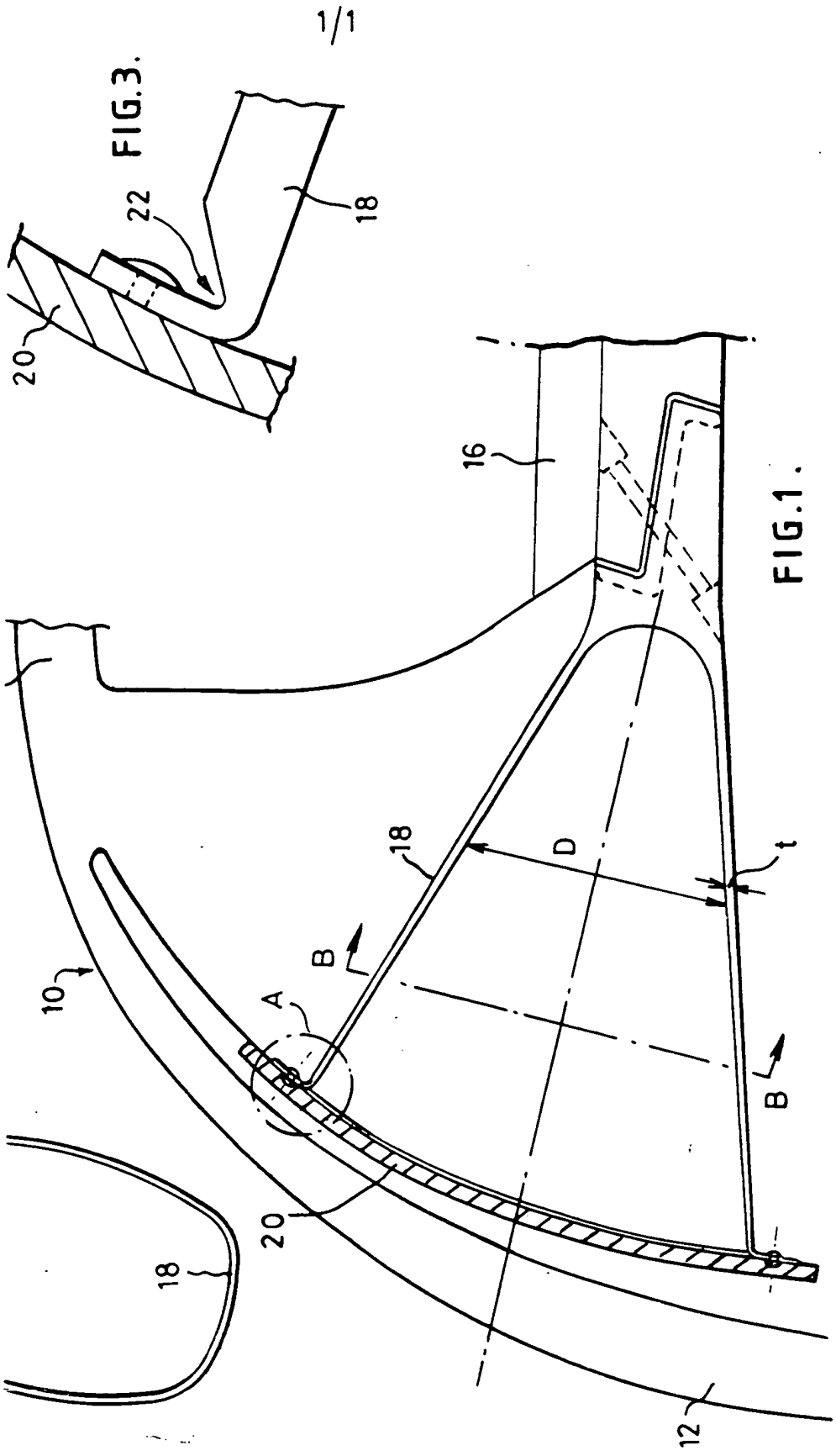

FIG.1.

FIG.3.